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ENGINEERING DESIGN FILE

Project/Task: Engineering Support of OU 7-13/14 RI/FS Study

Subtask: Pit 9 Interface

EDF Page 1 of 5

TITLE: Information Received from LESAT in Meeting on September 14, 1995

SUMMARY: This EDF contains information received from Kirt McKinley of LESAT in a meeting on September 14, in response to questions posed by the OU 7-13/14 feasibility study team.

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PIT 9 TREATMENT SYSTEM INFORMATION

Question 1. Based on a review of the OU 7-13/14 remediation objectives (TBD), what modifications would be required to the Pit 9 treatment system?

Answer: The Pit 9 treatment system was designed to handle everything in the SDA.

Question 2. What items on the attached table could not be processed by the Pit 9 treatment system?

Answer: There is nothing on Table 1 that can't be processed by the Pit 9 system except large metallic objects (size limit of hydraulic shears is about 6-inch diameter) and plutonium sources greater than about 500 grams. Large items would be left in place if met curie content limit, or lifted and decontaminated with water and CO_2. The decontamination fluid can be treated by the Pit 9 process. Modifications would be needed to get large objects out of the containment building. The Pit 9 system can handle up to 500 g of Pu in a single source, and sources with from 0.5 to 2 kg of Pu can be handled with difficulty. (The melter is limited to 500 g per batch of Pu for criticality reasons.) The system is designed for 200 mR/hr routinely, up to 1.5 mR/hr nonroutinely, and could handle waste greater than 1.5 R/hr on an exception basis.

Question 3. What effects will pyrophoric or reactive materials have on the performance of retrieval and treatment processes? Will modifications be required to handle or process them? Pyrophoric or reactive materials known to be present in the waste includes Pu fines; Zr and Zr alloy powder and chips; Na, NaK, and Mg metal; Hg/Li batteries, and sodium and potassium nitrates.

Answer: Pyrophoric materials can be handled by the Pit 9 process, as the retrieval, shredder, and melter feed systems are all inerted with nitrogen. Nitrates were processed in the POP tests. NaK can be processed. Explosive devices have been processed by the melter at Butte.

Question 4: What is the ultimate fate of tritium, C-14, Cl-36 and I-129 contained in waste processed by the treatment process?

Answer Chlorides and iodides will come out in the acid scrubber, as well as mercury and the portion of lead than is not incorporated in the melt (lead partitions 60% to melt/40% to offgas). The scrubber blowdown is stabilized in a sulfur-based cement. The estimated 1200 drums per year of this cemented waste is planned to be disposed of as low level waste at the SDA. LESAT is reviewing 3M's molecular filters as an alternative way to treat scrubber blowdown. Tritium and C-14 will be released out the stack as tritiated water or $^{14}CO_2$.

Question 5: How will pressurized gas cylinders be processed (ammonia and other gases)?

Answer: Cylinders in waste will likely be empty. If not, they will be sheared and their contents handled by the offgas system.

Question 6: What is the maximum capacity of each of the following subsystems: retrieval, shredding, magnetic separation, arc melter, BEST, preleach/leach, Ca precipitation? If the required throughput increased by a factor of 10, would any of these system have scale-up problems? What are the capacity bottlenecks of the Pit 9 treatment system?

Answer: The present capacity of the retrieval system is 500,000 ft^3/yr, based on 2 shifts per day. The capacity would be increased to 1,000,000 ft^3/yr by going to 4 shifts per day. The plasma melter capacity is 1000 lb/hr, and is limited by the offgas system. Upgrading the offgas system would double the melter capacity. The melter has an availability of 80-90%. The chemical treatment system is designed for 6000 lb/hr, and has a design availability of 60%, but will operate at about 80%. The leach system is based on a 5-hour leach residence time; throughput could be increased if shorter residence times prove sufficient. (Some soil and material treatability tests will be performed shortly in Las Vegas to better determine Pu forms. Large differences in residence time requirements were seen in leaching high-fired Pu from Los Alamos compared to Pu obtained from Rocky Flats.) No scale up would be needed to perform the OU 7-13/14 remediation, multiple systems would be used. The present bottleneck is the soil wash system.

Question 7: What steps would be added to the treatment system to decontaminate or process large items? What are the current waste size limitations for feed to the shredder and melter?

Answer: Two decontamination cells would be used, one in retrieval building for catastrophic failure, and one outside.

Question 8: What are the ultimate waste forms for lead and mercury?

Answer See answer to question 4.

Question 9: Will processing of HF-contaminated soil cause corrosion problems in any component of the system (melter, BEST, leach equipment, etc.)?

Answer: Hydrofluoric acid in low concentrations is good for the leach system. The leach system is designed for 14 molar heated nitric acid, thus no pH problems are expected. If high concentrations of HF are encountered, the waste would be diluted.

Question 10. What is the disposition of spent HEPA filters?

Answer: HEPA filters are recycled to the melter.

Questions specific to melter:

Question 1. What is the maximum metal content for melter feed?

Answer: Based on present data, it appears the limit on metal content is 70%, beyond that level metal begins to pool and slag fails TCLP test. If this value is validated, the Pit 9 metal feed limit would be set at 50%. The metal content will be estimate during retrieval and not be a tight limit.

Question 2. What test data are available on the incorporation of RCRA-hazardous metals and also beryllium into the melter slag, using RWMC or similar soils?

Answer: Additional data on volatile metals in melter are available from tests at Butte in the last year and a half, and the test bed tests at Ukiah next spring will generate additional data.

Question 3. How will Sr and Cs partition between plasma melter slag and offgas solids and between treated soil and TRU concentrate in the leach process?

Answer: Sr and Cs have boiling points intermediate to lead and cerium, which have shown partitioning to the slag of 60% and 99% respectively. Sr and Cs will be put in feeds to the melter in the test bed tests. Sr and Cs in soil will be leached in the chemical treatment system, concentrated in the evaporator, and precipitated as oxalates.

Question 4. What are the acceptable ranges or limits of soil/waste/metal feed to the melter?

Answer: Only the metal needs to be controlled. See answer to question 1.

Question 5. What is the partitioning of TRU elements between melter slag and metal?

Answer: There is no metal in the final product. In the POP test, 0.04% Pu volatilized.

Question 6. How does the melter control system respond to feed system changes?

Answer: The feed rate, torch power and oxygen flow to the oxygen lance are controlled. The air temperature is monitored and kept at 1800-2000°C to keep the melt at 1800°C. For endothermic feeds such as nitrates, the feed rate is reduced and torch power increased; for metals, which are very exothermic, the rate is increased and power decreased. The oxygen lance is used primarily for highly chlorinated organics; the oxygen flow is increased if smoking is observed.

Question 7. How much soda ash or other flux agents will be added to the melter feed? What is the composition of flux agents?

Answer: The POP test used soda ash, a combination of sodium carbonate and sodium oxide, to maintain a melt viscosity low enough to pour. Flux agents are only needed in the absence of metals. Lime could be used and will be tested in the test bed tests. A limiting factor in using lime may be its ability to liquify refractory.

Discussion of Containment During Removal of Overburden

Question: Design documents indicate that removal of overburden is not performed in double containment. Is this correct?

Answer: The containment building is in place during removal of the overburden. However the building is not maintained at negative pressure or with an inerted atmosphere during overburden removal.

Table 1. Wastes known to be present in SDA pits and trenches.

Construction and Demolition Material	Lumber, wallboard, concrete, steel plate, ducting, electrical wires, fuse boxes, roofing material, floor tile, insulation, lead sheet, lead brick, asphalt paving materials, soil, sand, gravel, steel stairways, ladders, plexiglas, leaded glass, glove boxes, asbestos, Benelex
Laboratory equipment and materials	Hoods, laboratory benches, desks, chairs, cabinets, glassware, plastic tubing, plastic and glass bottles, solutions stabilized in concrete or plaster, vermiculite, steel-copper crucibles, rubber hose, acid carboy, uranium film sampler, glovebox gloves, syringes, gas cylinders
Process equipment and materials	Air compressor, tanks, heat exchangers, tube bundles, condensers, piping, flanges, valves, ion exchange resins and columns, demineralizer, pumps and pump parts, motors, continuous air monitors, air conditioner, furnace coke, carbon baffles, HEPA filters, Raschig rings, electronic tubes and instruments, control panels, dissolver pots, drums of organic solvent
Nuclear reactor components, fuel, and radioactive sources	Irradiated hardware, core structural components, fuel scraps, fuel rods, graphite cuttings, reactor core, beryllium reflectors, Ra-226 and other sources, reactor vessel, fuel end pieces, Co-60 wires in concrete, irradiated fuel powder and pellets, Pu-coated disks, 55-gal drums embedded in 60-70 ft^3 of concrete shielding
Maintenance equipment and scrap metals	Hand tools, metal-working machines, drill presses, cranes, hoists, welders, oil and grease, metal filings, abrasive wheels, lathes, drum of machine coolant, scrap metals (Ag, Al, Be, Cd, Cu, Fe, K, Mg alloy, Mg-Th, Na, NaK, Pb, Sn, depleted Uranium, Zr and Zr alloys, others), backhoe parts
Decontamination Materials	Paper, rags, plastic bags and sheet, floor sweepings, brooms, steel wool, coveralls, hardhats
Miscellaneous	Sewer sludge, garbage, tires, lunchbox, animal tissue, carcasses, feces, botulinus-contaminated meat, jet engine, dump truck, trailers, forklift, pickup trucks, tanker, magnesium fluoride slag, solidified $CeCl_3$ solution, boric acid crystals, solidified evaporator sludge, contaminated mud, office equipment, lead-acid batteries, mercury batteries, barrels of Santo-R wax, tires, safe, camera, radios, casks, concrete cask with steel liner filled with solidified sludge